

A Merged Atmospheric Water Data Set from the A-Train

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Project hypothesis: Multiyear, simultaneous observations of atmospheric temperature and water vapor plus cloud liquid and cloud ice amounts will enable improved multivariate descriptions and modeling of cloud and hydrologic processes.

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What hydrologic states are observable with the A-Train?

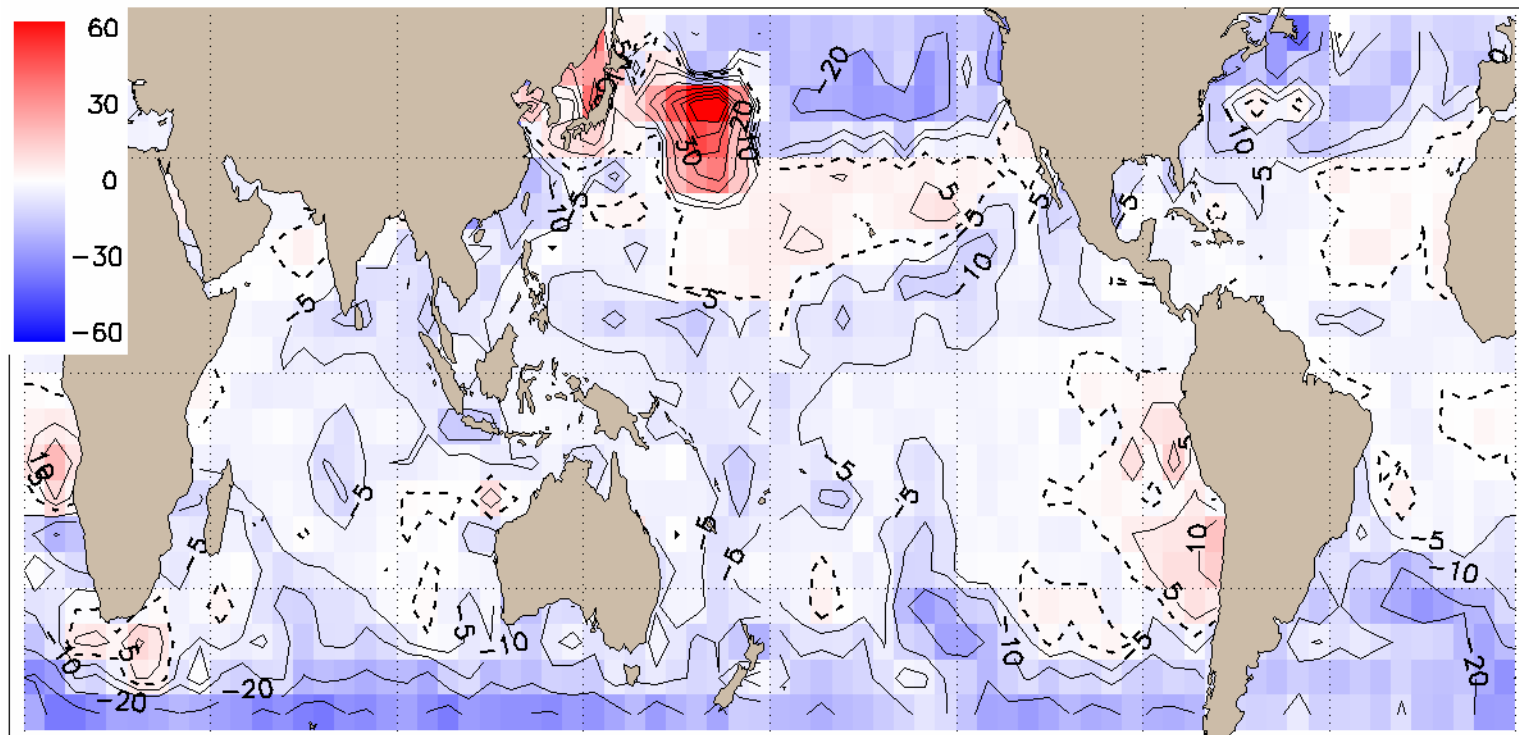
Objectives & deliverables:

- Objectives:
 - Reconcile retrieved quantities ('observations') from multiple instruments.
 - Characterize and/or constrain uncertainties.
 - Place observations on a common, nested (i. e., user-friendly) grid.
 - Preserve instantaneous relationships between variables.
 - Apply to Madden-Julian Oscillation (and other) studies.
- Deliverables:
 - Hierarchy of data sets (in rough order within subgroups):
 - *Quantities*: temperature, water vapor, cloud top properties, cloud liquid water, cloud ice.
 - *Geographic coverage*: oceans, land and ice.
 - *Space-time coverage*: A-Train period; tropics, midlatitudes and poles.
 - Publication of results; documentation.

Technical approach and/or methods:

- Comparisons:
 - AMSR-E-AIRS total water vapor.
 - Total water vapor from MODIS, AMSR-E and TES (A. Eldering & M. Garay).
 - Upper troposphere water vapor from AIRS and MLS (W. Read).
 - Cloud fraction and top pressure and temperature from AIRS and MODIS (B. Kahn).
 - Cloud ice from MLS and cloud top properties from AIRS (J. Jiang and B. Kahn).
- Anticipated future comparisons (NEWS-specific):
 - AMSR-E-MODIS cloud liquid water.
 - NOAA-16 AMSU-B cloud ice & other cloud properties.
 - Cloudsat with MODIS, AMSR-E, AIRS, MLS.
- Constrain uncertainties:
 - Look for wild inconsistencies.
 - Empirical error estimates.
 - Optimal estimation retrieval for AIRS; F. Irion and others are proceeding
- Place quantities on a common grid.
- Develop / guide statistical summaries.
- Apply data sets to real-world problems:
 - Current MJO study (B. Tian of JPL)
 - Others: upper trop processes; deep and shallow convection; multivariate distributions.

**Example of cross-comparison:
AIRS-AMSR-E total water vapor *sampling* biases vary in sign and magnitude
(but... point-by-point comparisons are unbiased!)**



$100 * (\langle \text{AIR} \rangle - \langle \text{AMSR-E} \rangle) / \langle \text{AMSR-E} \rangle$, 25 Dec 02 - 9 Jan 03

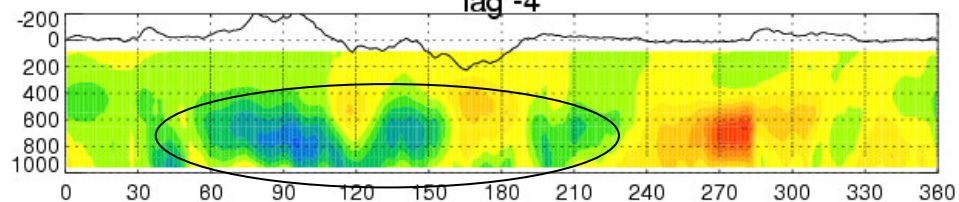
Fetzer et al., Biases in precipitable water vapor climatologies from AIRS and AMSR-E, submitted to JGR.

Madden-Julian Oscillation Water Vapor Composite

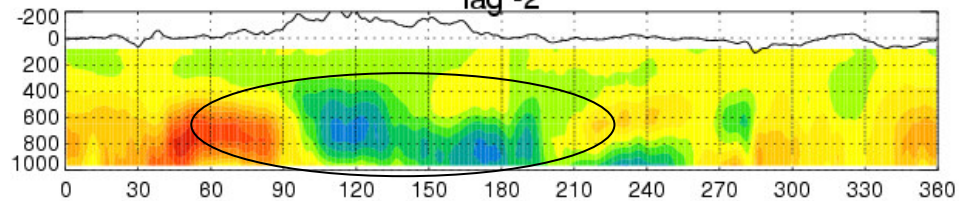
Courtesy Baijun Tian, Caltech

AIRS L3

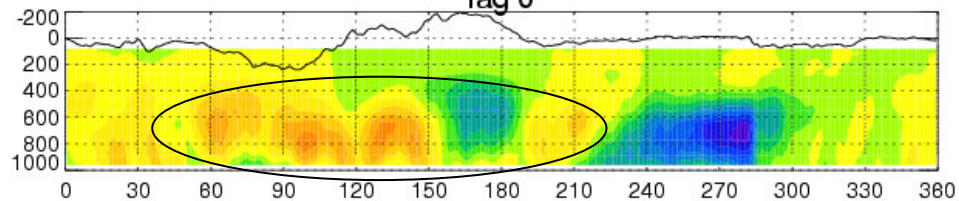
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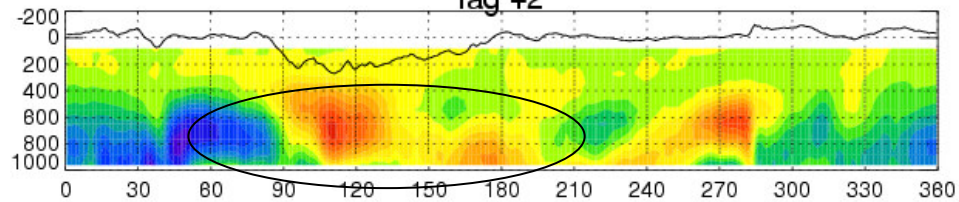
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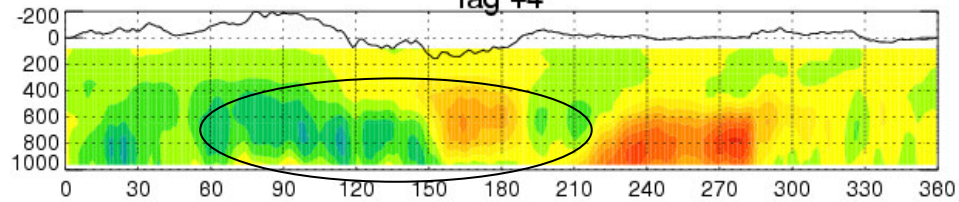
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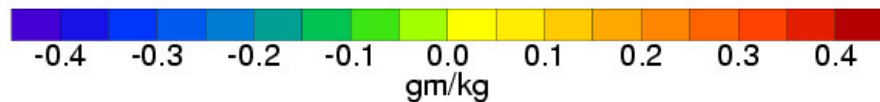
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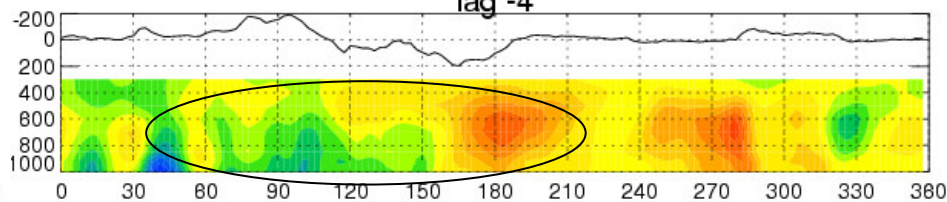


10S-10N H2OvapMMR MJO Anomaly

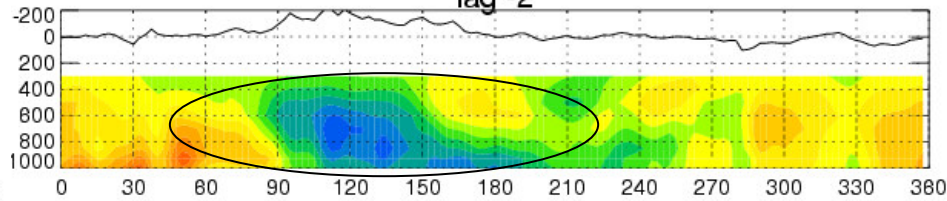


NCEP

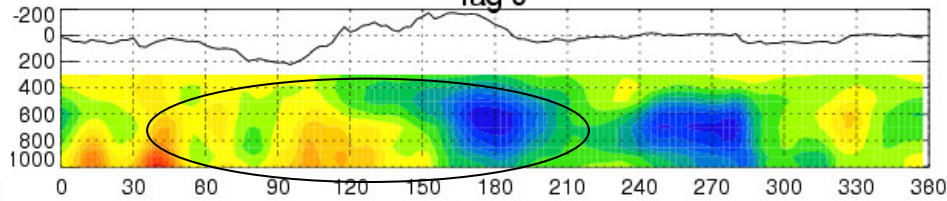
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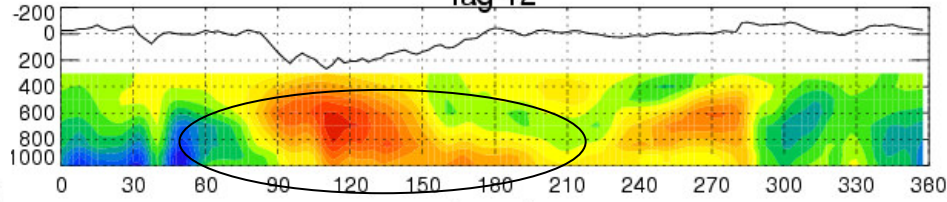
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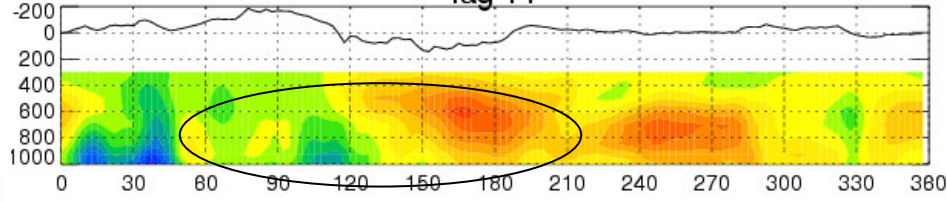
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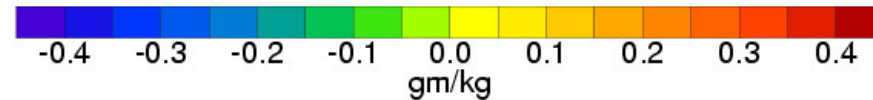
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10S-10N shum MJO Anomaly



Data set needs (in rough numbers):

- *Small:* AMSR-E, MLS, TES, AMSU-B, Cloudsat on NOAA 16 ; (~1 TB / year)
- *Medium:* AIRS (~1 TB / year)
- *Large:* MODIS (Several TB / year)

Project data outputs (in rough numbers):

- Temperature (~10 km horiz. resolution, surface to stratosphere): <1 TB / year
- Water vapor (~10 km horiz. resolution, surface to stratosphere): <1 TB / year
- Cloud ice water (~1-100 km along track): < 1 TB / year
- Cloudsat properties: <1 TB / year?
- Cloud top properties (~1-10 horiz. km resolution): 1-10 TB / year
- Cloud liquid water (~1-10 km horiz. resolution): 1-10 TB / year

Potential collaborations with NSIT, other NEWS projects, etc.:

- Products: Liu, Weilicki, Curry, Hornbuckle, Famiglietti, Wentz, etc.
- Analyses: Peters-Lidard, Bosilovich, L'Ecuyer, Soden, Betts, Schubert, Roads, Koster, etc.

Important linkages/resources outside the NEWS team:

- Dependencies:
 - All A-Train science teams; working with AIRS, MLS and TES, need more interactions with MODIS and AMSR-E.
 - The analysts listed on Page 2.
 - GENESIS II project; potential further collaboration with Machine Learning group at JPL.
- We are 'customer-rich':
 - Team member D. Waliser has many contacts.
 - Upper tropospheric research community; F. Irion is Co-I with A. Gettelman and W. Randel of NCAR; informally with A. Dessler and D. Waugh; W. Read has many contacts through MLS.
 - Shallow convective processes with J. Teixeira of NURC, La Spezia, Italy.
 - Tropical waves and convection with S. Leroy of Harvard.
 - Water vapor transport with T. Barnett and D. Pierce of Scripps.
 - Others...

Expected contribution to the NEWS objective:

- User-friendly merged data sets.
- Guidance on formulating analyses.
- Several-year record of instantaneous information about clouds and water vapor => multivariate probability distributions as observational constraints for, e.g., eddy-resolving models and superparameterizations.
- Analyses and climatologies of MJO processes, including cloud liquid and ice water variability.

Issues, needs, and concerns:

- Increasing difficulty:
 - temperature, water vapor, cloud top properties, cloud liquid water, cloud ice
 - free troposphere, boundary layer
 - ocean, land, polar regions
- Need prioritized (and realistic) needs of NSIT.
 - Proposal review comments and conversations with B. Lin have helped greatly.
- Well-posed science questions are always welcome.